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Foreign Animal Disease Report

United States Department of Agriculture

Animal and Plant Health Inspection Service

Veterinary Services

Emergency Program

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Emergency Field Operations

Foreign Animal Disease Investigations. During the first quarter of fiscal year (FY) 1990 (October 1, 1989 to December 31, 1989), veterinarians from the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) conducted 44 investigations of suspected foreign animal diseases to eliminate the possibility that an exotic disease may have been introduced into the United States. All investigation results were negative for exotic disease conditions. All Foreign Animal Disease Diagnosticians (FADD's) are required to make an official report of each investigation of a suspected foreign disease condition.

Training. Foreign animal disease training courses are scheduled for March 18-31, and May 6-19, 1990. The courses include 1 week at the National Veterinary Services Laboratories (NVSL), Ames, Iowa, and a second week at the Foreign Animal Disease Diagnostic Laboratory (FADDL), Plum Island, New York. Parts of the course curriculum that were formerly presented at Hyattsville, Maryland, have either been discontinued or incorporated into the presentations at NVSL or FADDL. A Military Support Course is planned for U.S. Department of Defense veterinarians, April 9-13, 1990, Hyattsville, Maryland. (Dr. John L. Williams, (301) 436- 8073)

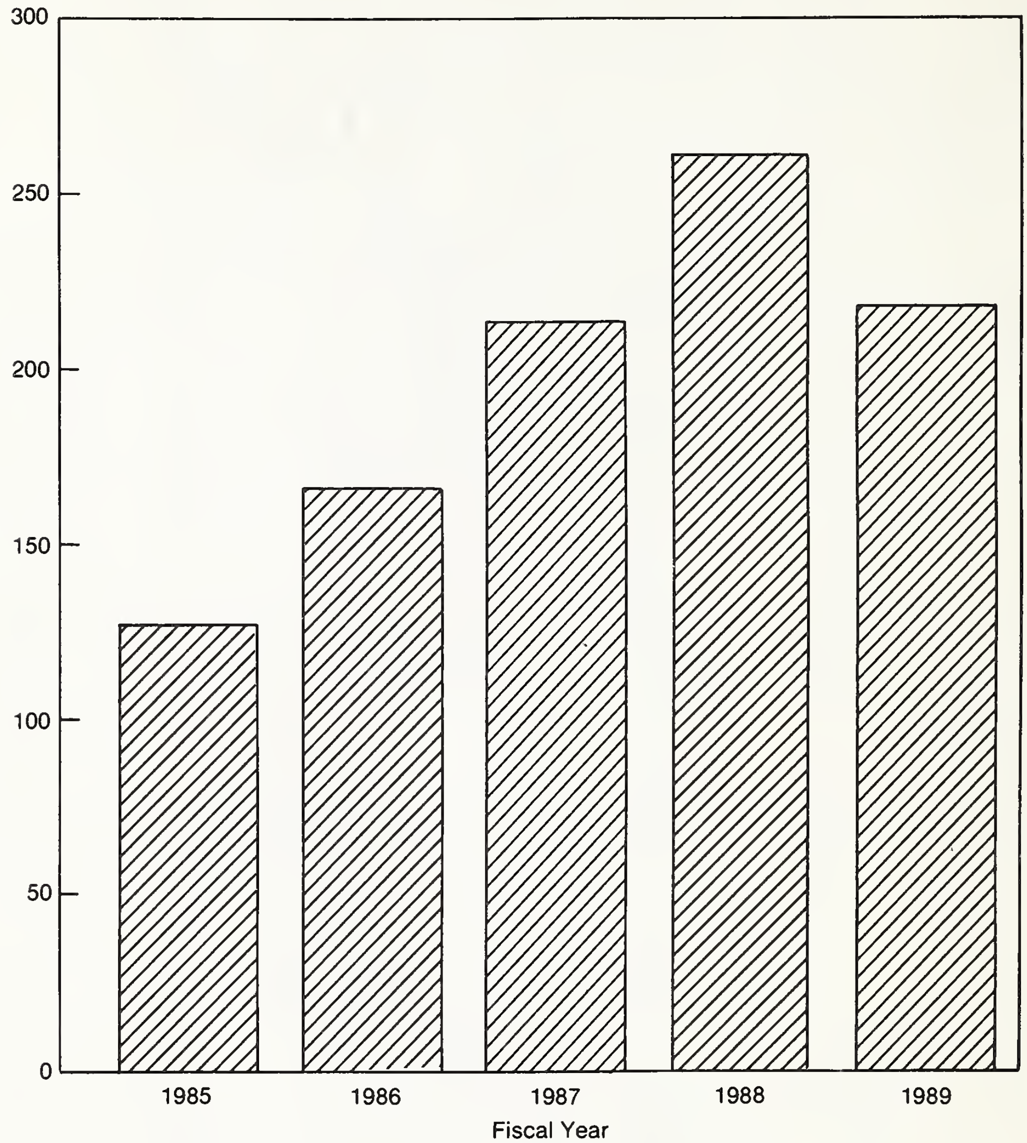
Investigations Summary 1985-1989

During the last 5 fiscal years (FY's), 1985-89, there have been 981 field investigations for suspected foreign animal diseases (FAD's) in the United States. Figure 1 shows annual totals for these field investigations: 1985, 126; 1986, 165; 1987, 213; 1988, 260; and 1989, 217.

FAD field investigations were categorized by the disease condition that was initially suspected: vesicular disease (foot-and-mouth disease, swine vesicular disease, vesicular exanthema), mucosal disease (rinderpest, peste des petits ruminants, malignant catarrhal fever), hog cholera and African swine fever, equine encephalitis (Venezuelan equine encephalomyelitis), avian influenza (lethal or highly pathogenic avian influenza), Newcastle disease (velogenic viscerotropic Newcastle disease or

Figure 1.

Annual total of emergency field investigations for suspected foreign animal diseases.

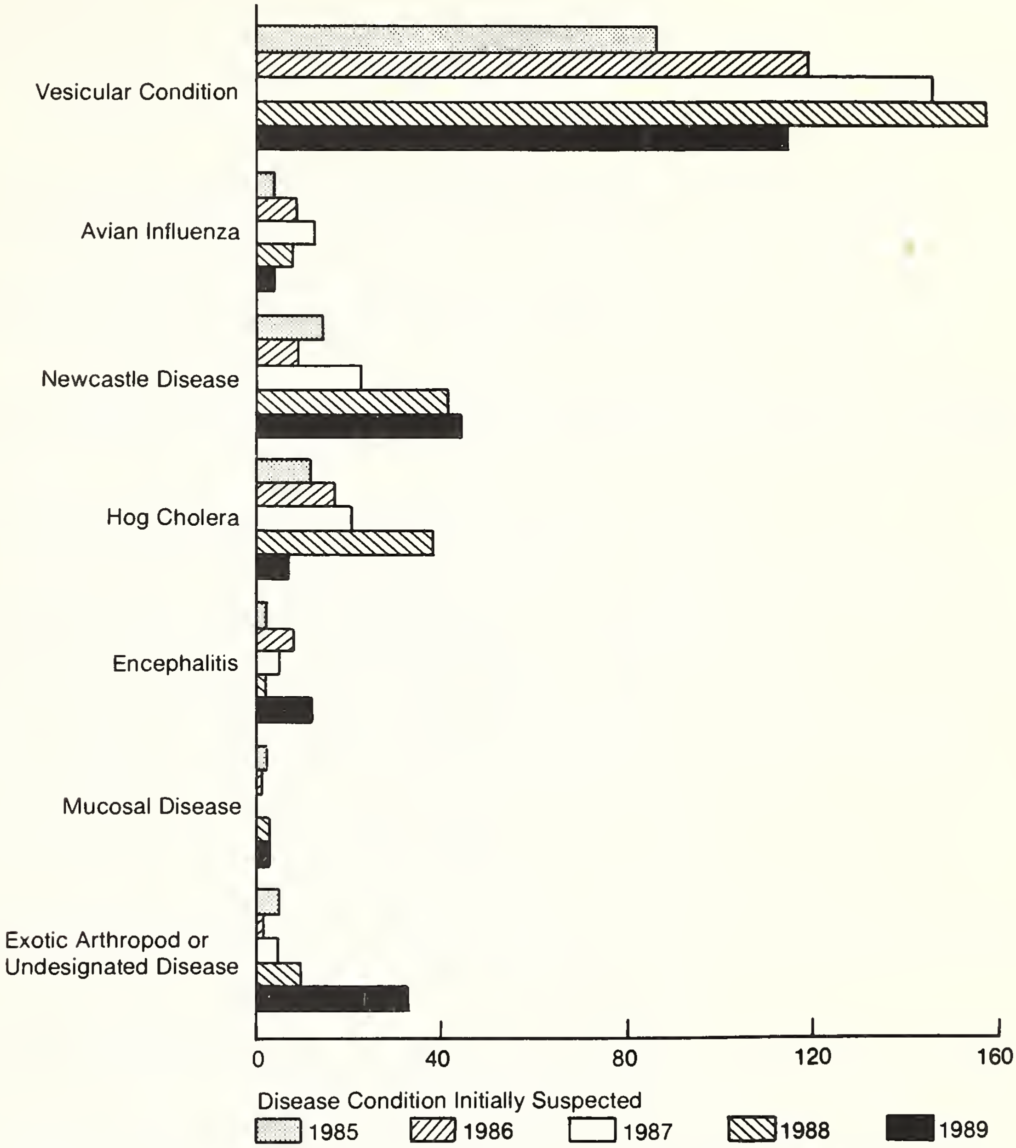


exotic Newcastle disease), and undesignated disease (screwworms, exotic ticks, or undesignated conditions). Figure 2 shows the total numbers by category of suspected foreign diseases and pests of livestock and poultry investigated by specially qualified foreign animal disease diagnosticians for FY1985-89.

No foreign diseases were identified in livestock or poultry. Diagnoses of exotic ticks, and exotic Newcastle disease in smuggled pet birds are reported elsewhere in the Foreign Animal Disease Report (FADR). (Dr. Adam G. Grow, (301) 436- 8073)

Figure 2.

Annual total emergency field investigations for categories of suspected foreign animal diseases.



Water Buffalo Import-Export

The U.S. Department of Agriculture (USDA) is monitoring a project in Trinidad and Tobago involving the importation of water buffalo into the United States. A VS veterinarian is monitoring the pre-export isolation, testing, and treatment of these water buffalo in Trinidad. Once the animals have cleared a required 60-day isolation period, they will be eligible to be shipped to the United States. Upon arrival, they will undergo quarantine at USDA's New York Animal Import Center, Newburg, New York, for a minimum of 30 days.

The water buffalo are being isolated in a USDA-approved, tick- free isolation center in Trinidad. They had been inspected and treated for ticks prior to entering the isolation center, where they were also tested for the following: brucellosis (negative serum agglutination test in a 1:25 dilution), tuberculosis (negative intradermal tuberculin test), vesicular stomatitis (negative serum neutralization tests), *Trypanosoma vivax* (negative direct immuno-florescent antibody test), *Cowdria ruminantium* (heartwater) (negative indirect fluorescent antibody test), and bluetongue (negative agar gel immunodiffusion test or negative virus isolation).

The buffalo will again be treated for ticks prior to leaving for the United States. All tests except for bluetongue will be performed again at the New York Animal Import Center.

This is the second importation of water buffalo that has been permitted from Trinidad. The importer has expressed an interest in performing this type of import on an ongoing basis. (Dr. George O. Winegar, (301) 436-5097)

Foreign Animal Disease Update

The Office International des Epizooties (OIE) reported the following diseases during the months of July, August, and September 1989:

No **swine vesicular disease** or **fowl plague** was reported during the period.

In South America, Argentina reported 35 outbreaks of **foot-and-mouth disease** (FMD) types A, O, or C. Bolivia reported 2 outbreaks of FMD type C in May. Colombia reported 46 outbreaks of type A and 32 outbreaks of type O. Paraguay reported 11 outbreaks of type O and 13 untyped FMD outbreaks. Uruguay reported outbreaks of FMD types O and C, and Venezuela reported 23 outbreaks of types A or O.

In Europe, Italy reported one outbreak of FMD type C in July, involving 60 cases and 497 exposed animals. FMD has not been reported in Italy since July 1989.

In the Middle East, Israel has again reported FMD type O. An outbreak of type Asia 1 also occurred in Israel in June involving 400 animals. Outbreaks continued in Oman with 27 outbreaks of type O reported during May, June, and July. Saudi Arabia and Yeman each reported 1 outbreak of FMD type O in August. Turkey reported 34 outbreaks of type O with 108 cases and 68,231 animals exposed. Turkey also reported 31 cases of type A in 14 outbreaks with 25,077 animals exposed.

In Africa, Chad reported outbreaks of untyped FMD each month between January and July. Kenya reported outbreaks of FMD types A, O, SAT 1, and SAT 2. In May, 37 outbreaks of FMD involving 27,656 animals occurred in Zimbabwe.

In Asia, Cambodia reported outbreaks of type O in July. Iran reported 71 outbreaks of untyped FMD during the first quarter of 1989. Iran also reported outbreaks of FMD type O during the same period. Pakistan reported recurrences of FMD types O, A, and Asia 1 during the third quarter of 1989. Thailand reported monthly outbreaks of untyped FMD during the first half of 1989 and the Philippines reported occurrences of type C during August.

In South America, Colombia reported 30 outbreaks of **vesicular stomatitis** (VS) serotype Indiana (IN) and 26 outbreaks of serotype New Jersey (NJ).

In Central America and Panama, VS-IN was reported in Costa Rica, El Salvador, and Panama. VS-NJ was reported in Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Panama, and Venezuela. Reports received from the Pan-American Health Organization (PAHO) also indicate that outbreaks of VS-NJ were reported in Nicaragua.

Kenya reported **rinderpest** in May, and the Sudan reported one outbreak in July, exposing 2,000 animals to the disease.

Peste des petits ruminants (PPR: pest of small ruminants) was reported from northwest Africa and the Arabian peninsula. Ghana reported outbreaks of PPR in February and March. The Ivory Coast reported monthly occurrences of PPR from January to August 1989. Oman reported 39 outbreaks from March through July, with 757 animals exposed.

Contagious bovine pleuropneumonia (CBPP) was reported from Africa, Europe, and Asia: in the Ivory Coast from January to September, and in Mali in October; in Guadalix de la Sierra and Escalona del Prado, Spain, in September; and in Benin, Chad, Kuwait, and Kenya.

In Africa, **lumpy skin disease** (LSD) was reported in the Congo in June, in Egypt during May through August (146 outbreaks), and in Ghana during the first half of 1989 (19 outbreaks). The Ivory Coast reported monthly occurrences during the first half of 1989 and in August. Kenya reported LSD in May, June, and July. Madagascar reported 67 outbreaks of LSD from February to May. South Africa reported LSD in June, July, and August, and Zambia had 3 outbreaks in April and in May. Zimbabwe reported 3 outbreaks of LSD with 14 cases in May. In the Middle East, Israel reported 68 cases of LSD with 637 animals exposed, in September.

Rift Valley Fever was reported in Kenya and Zambia between April and June 1989.

Bluetongue was reported in Israel, Malaysia, South Africa, Kenya, Zimbabwe, and the United States.

Sheep and goat pox (SGP) was reported in Africa, the Middle East and Asia. Algeria reported 16 outbreaks of SGP and the Ivory Coast reported monthly outbreaks from January through August. Kenya reported outbreaks of SGP during May, June, and July and Madagascar reported 16 outbreaks with 154 cases from February through April. Six outbreaks of SGP were reported in Morocco during July and September. Cyprus reported 18 outbreaks of SGP with 414 cases and 2,578 animals exposed. Oman reported 10 outbreaks of SGP from March through July and Turkey reported 90 outbreaks with 1,440 cases and 632,250 animals exposed between June and August. Iran reported 64 outbreaks of SGP during January through March. Kuwait reported 14 outbreaks of SGP with 305 cases and 4,810 animals exposed during June, July, and August and Pakistan reported outbreaks during June, July, and August.

African horse sickness (AHS)—was reported from Europe and Africa. Spain reported 71 outbreaks during August and September, with 21,249 animals exposed and 334 animals destroyed. Portugal reported 4 outbreaks of AHS during September with 4 cases and 22 animals exposed. Kenya reported AHS during May and June. South Africa reported AHS during June, July, and August and Zimbabwe reported outbreaks during May.

African swine fever (ASF) was reported in Europe, in Italy during July through September, in Portugal during June and July (46 outbreaks with 3,214 animals exposed), and in Spain during April through September (104 outbreaks with 12,146 animals exposed and 2,225 animals destroyed). In Africa, Malawi reported 4 outbreaks of ASF in June and July and South Africa reported outbreaks in August. Zambia reported AHS in April and May.

Hog cholera (HC) was reported from South America, Europe, Asia, Africa (Madagascar), and Mexico. Mexico reported 115 outbreaks of HC in August with 792 cases and 3,255 animals exposed, and 7 outbreaks in June and July with 268 cases and 2,365 animals exposed. Argentina reported HC during April, May, and June; Colombia reported cases during June, July, and August; and Paraguay reported 192 cases during June through September. Uruguay reported 6 cases of HC in June and Venezuela reported outbreaks from April to August. Austria reported 18 cases of HC in September. In July, Belgium reported 3 outbreaks of HC in which 2,377 exposed animals were destroyed. The Federal Republic of Germany reported 28 outbreaks of HC with 2,354 cases in which 2,274 animals were exposed and 2,145 animals destroyed. Italy continued to report HC, July through September. Seven outbreaks of HC were reported in Madagascar, between February and April. Korea reported 8 outbreaks of HC with 104 cases during June and August, and Malaysia reported 3 outbreaks in May and June with 45 cases and 1,290 animals exposed. Taiwan reported 11 outbreaks of HC in August and September, with 519 cases, 3,317 animals exposed, and 272 animals destroyed.

Teschen disease was reported in Madagascar during February, March, and April, with 16 outbreaks and 154 cases.

Newcastle disease (ND) was reported in Africa: Algeria, Botswana, the Congo, Egypt, Ghana, the Ivory Coast, Kenya, Madagascar, South Africa, and Zambia; in South America: Colombia; in the Middle East: Turkey and Oman; in Europe: Albania and Yugoslavia; and in Asia: Hong Kong, Iran, Japan, Korea, Kuwait, Malaysia, Pakistan, and Taiwan. The disease was not classified and is considered to be velogenic.

Velogenic viscerotropic Newcastle disease (VVND) was reported in Malaysia, Pakistan, Namibia, Panama, and South Africa. Malaysia reported 9 outbreaks of VVND during March through June, with 12,118 cases and 55,200 birds exposed. Namibia reported VVND in August and September with over 8,000 cases and 40,000 birds exposed. VVND was reported in Pakistan and South Africa in June, and in Panama in August.

Necrotic hepatitis or **viral hemorrhagic disease (VHD)** of rabbits was reported in Mexico in September. The disease was limited to a backyard rabbit colony in Saltillo, Coahuila. In October, another focus of VHD was detected near Monterrey, Nuevo Leon. All infected and exposed animals were destroyed. Two foci of infection were found during December in Tlalmanalco and Ixtapaluca, by antibody tests. Vaccine is suspected as the cause of the antibodies that were found.

Information reported during July, August, and September may include previously unreported data from prior months. In some instances, diagnosis may be strictly clinicopathologic without laboratory confirmation. (Dr. M. J. Gilsdorf, APHIS, USDA, IS, Hyattsville, Maryland 20872, (301) 436-8892)

Bovine Embryo Import-Export

Embryo transfer offers new import and export opportunities for the livestock industry. For the Animal and Plant Health Inspection Service (APHIS), it represents new potential risks of animal disease introduction which must be prevented. However, the risks can be minimized if the diseases which can be transmitted through the embryo or through contamination are known.

Currently, embryos are not permitted entry into the United States from countries in which FMD exists. However, the United States does have regulations for the importation of embryos from countries free of FMD and rinderpest. The importer is required to obtain an import permit from APHIS which specifies the health requirements which must be met for importation. These requirements are based on the status of the exporting country for certain other significant animal diseases.

Animal health officials in most countries are concerned with the introduction of disease via embryos that have not been properly collected, washed, or certified. APHIS must assure the importing country that the embryos being exported from the United States are free of disease. This again raises the question of the embryo's capacity to transmit disease agents.

To help answer that question, APHIS established a committee in 1988 to evaluate the risk of transmitting animal disease agents through embryo transfer. The committee is composed of APHIS and Agriculture Research Service (ARS) scientists who are knowledgeable about embryo transfer, specific disease agents, or both. The committee is charged to: (1) review current research data, (2) determine if the risk can be evaluated with the information that is available, (3) recommend a policy to the APHIS Administrator for procedures which permit both domestic and international movement of embryos with minimal disease risk, and/or (4) recommend additional research that is needed to make a determination.

Recommendations of the committee's first meeting were accepted by APHIS Administrator Dr. James Glosser. They include APHIS policy for moving bovine embryos free of the viruses of FMD, bluetongue, and enzootic bovine leukosis (EBL). The policy will be amended if additional data suggest different risk parameters. For EBL, APHIS believes that the risk of transmitting leukosis through embryo transfer is very low, even if the dam and sire are infected. Therefore, for importation into the United States, the only EBL requirement is that the processing and storage be conducted according to International Embryo Transfer Society (IETS) standards.

APHIS believes that the risk of FMD transmission by embryo transfer is minimal, provided that (1) the donor is not viremic at the time of collection, (2) the embryos have intact zona pellucida, and (3) the embryos are properly washed. Therefore, based on current data, APHIS believes that bovine embryos can be transferred safely if (1) the herd is certified free of FMD by the veterinary officials in the country of origin, (2) collection, washing, packaging, and storage of the embryos are conducted under IETS standards and are directly supervised by an APHIS veterinarian, and (3) serum neutralization and virus infection associated antigen (VIAA) tests conducted at the Plum Island Foreign Animal Disease Diagnostic Laboratory (FADDL) on the donor cow, both at the time of embryo collection (first test) and 30 to 60 days later (second test), verify the absence of FMD virus. The specimens for the second test are to be collected by a government veterinarian of the country of origin.

The test results required and risk acceptability are indicated in the following table.

First test	*Second test*	*Acceptable*
SN - negative	SN - negative	yes
SN - negative	SN - positive	no
SN - positive	SN - positive	yes (if the titer is less than a 4-fold increase)
VIAA - negative	VIAA - negative	yes
VIAA - negative	VIAA - positive	no
VIAA - positive	VIAA - positive	yes (if the SN test has less than a 4- fold increase)

For ovine and caprine embryos, APHIS policy concerning FMD requires (1) herd health certification by a veterinary official of the country of origin, (2) direct supervision of collection, washing, packaging, and storing by an APHIS veterinarian, and (3) negative SN and VIAA tests of the donor female on 2 separate occasions: at the time of collection (under APHIS supervision), and 30-60 days later, of specimens collected under the supervision of a government veterinarian of the country of origin.

For bluetongue, current APHIS policy requires only zona pellucida intact bovine embryos which have been washed under the IETS standards. No serologic or virus isolation testing is required.

For bluetongue, APHIS policy also requires tests of the ovine and caprine donor females between 30 days and 1 year after embryo collection, with negative test results. The test of choice would be the agar gel immunodiffusion (AGID) test. Collecting embryos from AGID test-positive animals should be avoided unless further research on bluetongue in sheep and goats verifies the safety of the procedure.

For brucellosis, current APHIS policy requires all bovine embryos be washed under IETS guidelines, and all donor cows be tested and found negative for brucellosis 21 days or more after embryo collection, or originate from officially certified brucellosis-free herds, States, or countries. If tested and found serologically negative, then no further requirements are necessary. If the serological test is positive or the donor is culture positive, then the following would also be required: a. for import purposes, deny importation. b. for domestic purposes, the IETS washing procedure should include antibiotics and the recipient animal must be quarantined from the time of transfer until a negative retest is performed at least 30 days after calving.

For tuberculosis, current APHIS policy requires washing bovine embryos under IETS standards, and a negative intradermal tuberculin test of the donor at the time of collection or within 1 year after collection; or washing under IETS standards, and the donor originated in a herd or State that complies with the accredited free APHIS herd or State requirements provided in the USDA's tuberculosis uniform methods and rules. For domestic purposes only, if APHIS receives requests to allow the collection of embryos from tuberculosis reactors, APHIS will require washing of the embryos according to IETS standards. In addition, a negative test and quarantine of the recipient prior to transfer are required. The recipient and her calf must remain under quarantine until they pass a negative test 6 months after parturition.

For scrapie, current APHIS policy requires that (1) ovine embryos be washed under IETS standards, (2) the donor female and semen donor male be 5 years of age or older, and (3) mesenteric lymph nodes from the embryo donor be surgically collected at the time of embryo collection, for inoculation into at least six mice. The embryos must be held in quarantine under APHIS supervision for approximately 18 months until the mouse inoculation test is negative. If the mice show signs of scrapie, confirmed by histopathology, within the 18-month incubation period, the embryos would become the property of APHIS for use in scrapie research. The semen which was used to produce the embryos must also pass the mouse inoculation test. If the test is positive, the embryos would become the property of APHIS and would be used for scrapie research.

More diseases will be evaluated and research needs identified during future meetings of the APHIS Embryo Transfer Committee. APHIS is also working with IETS, the American Embryo Transfer Association (AETA), and others to advise the International Office of Epizootics (OIE) on international standards for controlling embryos, general conditions, collection units, processing laboratories, donor animals, testing of donor animals, ova, and embryos, optional tests and treatments, and embryo storage, quarantine, and transportation. With the development of new standards and research data, the number of tests required for safe embryo importation should decrease.

The number of embryos being transported within the United States and internationally has increased dramatically in recent years. APHIS foreign animal disease diagnosticians should be alert to the risks that this trend represents and, when called upon to investigate a potential disease problem, obtain detailed histories on any semen and embryos that have been brought into a herd. More research information is needed to provide indisputable evidence on embryo disease transmission capability for each species, and the means to safely transfer animal embryos free of many of the significant diseases of concern to livestock producers. (For copies of the IETS standards, please contact one of the authors of this article: Dr. M. J. Gilsdorf, USDA, APHIS, IS, (301) 436-8892; or Dr. G. O. Winegar, USDA, APHIS, VS, IEA, Federal Building, Hyattsville, Maryland 20782, (301) 436-5097.)

Wildlife Investigations

This article summarizing the manner in which wildlife diseases are investigated in the United States was abstracted from an earlier published report: Glosser, J. W., and V. F. Nettles. Rev. Sci. Tech., OIE, 7(4):797-805, 1988.

Primary responsibility for the health of wildlife in the United States resides with U.S. Department of Interior (USDI) Fish and Wildlife Service (USFWS) and the fish and wildlife agencies in the individual States. Because diseases of wildlife can directly affect the health of humans and domestic animals, Federal and State public health organizations and agricultural agencies perform wildlife disease research, diagnostic investigations, epidemiological studies, and control programs. In all, 3 Federal agencies and more than 150 State or territorial fish and wildlife agencies, agricultural agencies, and public health agencies carry out activities related to wildlife diseases. Many efforts are collaborative and may include scientists from universities, zoological facilities, and the U.S. Department of Defense (USDOD).

Major laboratories within the Federal Government and States have been identified for wildlife and public health investigations. Notable among these are the USFWS National Wildlife Health Research Center, Patuxent Wildlife Research Center, National Fish Health Center, and the U.S. Department of Health and Human Services' Centers for Disease Control.

Wildlife disease activities in agricultural agencies are considered particularly important because the success or failure of livestock and poultry disease control or eradication programs may depend upon the occurrence of certain diseases in wild animals which can be principal, reservoir, or amplifying hosts. Knowledge of the role of wildlife in disease transmission is especially critical when exotic animal diseases are introduced and eradication is contemplated. USDA, APHIS has made substantial preparations to address wildlife concerns if a foreign animal disease is introduced. APHIS maintains formal agreements with Federal and State fish and wildlife agencies to cooperate in wildlife disease investigations and has incorporated wildlife expertise into the organizational structure of its four Regional Emergency Animal Disease Eradication Organizations (READEO's). APHIS also has a long-standing cooperative agreement with the Southeastern Cooperative Wildlife Disease Study (SCWDS) at the University of Georgia which has proven especially helpful in preparations to respond to emergency disease outbreaks. Topics addressed by SCWDS in cooperation with APHIS personnel include African swine fever, hog cholera, lethal avian influenza, exotic Newcastle disease, and several indigenous livestock and poultry diseases. (Dr. Victor F. Nettles, Southeastern Cooperative Wildlife Disease Study, University of Georgia, Athens, Georgia 30602, (404) 542-1741)

Chicken Hydropericardium

Hydropericardium syndrome (HpS) of chickens (Angara disease) was first diagnosed in the village of Angara Goath near Karachi, Pakistan, in March 1987 (Jaffery, M. S., A treatise on Angara disease. Published by Pakistan Veterinary Medical Assn., Karachi, Pakistan). It has since appeared in flocks throughout Pakistan, resulting in the death of over 100 million broiler chickens.

Cause. Although gross and histological lesions of inclusion body hepatitis may be seen in HpS and adenoviruses have been detected by electron microscopy in livers of naturally infected chickens (Cheema, A. H.; Ahmad, J.; and Afzal, M. An adenovirus infection of poultry in Pakistan. Rev. sci. tech. Off. Int. Epiz., 8: 789-795, 1989), recent experimental results suggest that adenovirus may not be the cause of HpS.

Epidemiology. HpS is seen almost exclusively in broiler chickens 3 to 6 weeks of age, although cases have been reported in layer and breeder chicks. HpS appears suddenly at around 20 days of age. The course of the disease is usually 10 to 14 days, during which mortality can reach 75 percent. Transmission can be vertical, horizontal, or by vaccine contamination.

Clinical Signs. No clinical signs of HpS have been reported in field cases. In experimental cases, feed and water intake was reduced by 25 percent on post-inoculation (PI) day 2, and by 50 percent on PI day 3. Some inoculated birds had ruffled feathers and were reluctant to move. Infected birds started dying on PI day 3. The death rate was as high as 100 percent, and decreased with dilution of the inoculum. The volume of fluid in the pericardial sac increased with the duration of illness (Muneer, M. A.; Ajmal, M.; Arshad, M.; Ahmad, M. D.; Chaudhry, Z. I.; and Khan, T. M. Preliminary studies on hydropericardium syndrome in broilers in Pakistan, Zootecnica Internat., 46-48, May 1989).

Gross lesions. The most prominent lesion of HpS is the accumulation of up to 20 ml of clear, watery or jellylike fluid in the pericardial sac. The sac itself is transparent except in rare cases when it is translucent. The fluid color is white, amber, or, occasionally, green. The heart is misshapen and flaccid. There may be congestion and edema in the lungs. The liver is swollen, pale, and friable. The kidneys are enlarged and pale.

Geographic location. HpS has only been diagnosed in Pakistan. There have been no reports of a similar disease in the United States.

Control. A formalized vaccine prepared from the homogenated livers of experimentally infected chickens is 80 to 90 percent effective in preventing HpS when subcutaneously inoculated in 10-to 12-day old broiler chicks (Chishti, M. A.; Afzal, M.; and Cheema, A. H. Preliminary studies on the development of vaccine against the "Hydropericardium Syndrome" of poultry, Rev. sci. tech. Off. Int. Epiz. 8:797- 801, 1989).

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FOCUS ON — SWINE BLUE EYE DISEASE

Blue eye disease is a new disease of pigs associated with a paramyxovirus infection, and characterized by central nervous disorders, reproductive failure, and corneal opacity.

BEP History

The disease emerged in 1980 in central Mexico with numerous outbreaks of encephalitis and corneal opacity in piglets, from which a hemagglutinating virus was isolated (Stephano, H. A., Gay, G. M., Memorias de la Runion de Investigacion Pecuaria en Mexico. Mexico, D.F., 523, 1983. The virus was identified as a member of the paramyxoviridae group (Stephano, H. A. and Gay, G. M. Proceedings 8th Internat. Pig Vet. Soc. Congr., Ghent, Belgium: 71, 1984. Stephano, H. A. and Gay, G. M. Sintesis Porcina, *4*(5):42-49, 1985), and was shown to be serologically unrelated to previously described paramyxoviruses (Stephano, H. A., Gay, G. M., and Kresse, J. Proc. 9th Internatl. Pig Vet. Soc. Congr., Barcelona, Spain:455, 1986).

The first outbreak was observed in a commercial farm with 2,500 sows, located in La Piedad, Michoacan. Similar outbreaks were observed on other farms in Michoacan, Jalisco, and Guanajuato. In 1982, the disease was diagnosed in the Estado de Mexico; and in 1983, in the Federal District, Nuevo Leon, Hidalgo, Tlaxcala, and Queretaro. Also in that year, affected pigs were identified in slaughter houses in Tabasco and Yucatan. Outbreaks also occurred in 1984 in Tamaulipas and, in 1988, in Puebla and Campeche. The main focus of the disease remains in central Mexico, in the states of Michoacan, Jalisco, and Guanajuato, where there is a dense population of pigs.

Stephano and Gay experimentally reproduced the disease in 1983 by inoculating 1 day-old piglets with blue eye paramyxovirus (BEP) by different routes (Stephano, H. A. and Gay, G. M. Proc. 8th Internatl. Pig Vet. Congr., Ghent, Belgium:71, 1984). In 1984, reproductive failure was induced by inoculating BEP in pregnant sows at different times during gestation (Stephano, H. A. and Gay, G. M. *ibid.* 1984; Stephano, H. A., and Gay, G. M. Proc. 19th Congr. Mexican Assn. Vet. Swine Specialists, Mazatlan, Sinaloa:83-85, 1984).

In the first outbreaks, piglets were mainly affected, and mortality with nervous system disorders was uncommon in pigs more than 30 days old. Severe outbreaks of encephalitis have occurred since 1983 on fattening farms. Outbreaks were severe during 1984-85 in central Mexico (Stephano, H. A., and Gay, G. M. Sintesis Porcina

4(2):9-12, 1985; Stephano, H. A., and Gay, G. M. Proc. 20th Congr. Mexican Assn. Vet. Specialists in Swine, Merida, Yuc., Mexico:71-74, 1985). It was not until 1983 that reproductive failure in sows and transient infertility in boars were identified (Stephano, H. A., and Gay, G. M. Medicina Veterinaria, *3*:359-362, 1986). In 1987, a severe BEP problem appeared in boars, with orchitis, epididymitis, and testicular atrophy.

Swine blue eye has been reported only from Mexico. Clinical signs similar to those described in blue eye disease have been observed only in swine.

BEP Etiology

BEP is easily recovered from the brain, tonsil, and lung of affected animals in outbreaks of blue eye disease (Stephano, H. A., and Gay, G. M. Syntesis Porcina *5*:(12):26- 39, 1986; Stephano, H. A., Gay, G. M., and Ramirez, T. C. Vet. Record *122*:6-10, 1988). Strain differences have been described (Stephano, H. A., and Gay, G. M. Proc. 23rd World Vet. Congr., Montreal, Quebec, Canada:161, 1987).

BEP replicated in chicken embryos and monolayer cell cultures of primary pig kidney, bovine thyroid, bovine embryo, equine dermis, swine testicle, cat kidney; BHK 21, vero, and pig kidney (PK) 15 cell lines. The virus produced syncytia in primary pig kidney and PK15 monolayer cultures.

Supernatant fluid from cultures agglutinated erythrocytes from chickens, guinea pigs, mice, rats, rabbits, hamsters, cattle, horses, pigs, goats, cats, dogs, and humans (four blood types). Spontaneous elution occurred after 30 to 60 minutes at 37° C. Infected PK15 cells adsorbed chicken erythrocytes.

Viral infectivity was abolished by treatment with ether, chloroform, formalin, and beta-propiolactone, but resisted Actinomycin D. Formalin treatment inactivated viral replication and inhibited hemagglutination. The virus was inactivated after 4 hours at 56° C, and had a buoyant density of 1.21 g/ml in sucrose gradients.

Electron microscopic examination showed particles similar to paramyxovirus, measuring from 135 x 148 nm to 257 x 360 nm. The virion was pleomorphic, but usually more or less spherical. No filamentous forms have been observed. The envelope was covered with a layer of closely spaced surface projections or spikes. Nucleocapsids from disrupted viral particles were frequently seen as single entities with diameters of 20 nm x 1,000 nm to 1,630 nm long. The virus was seen in PK15 cell cytoplasm, occasionally in inclusion bodies.

Serological analyses showed that specific antiserums prepared against paramyxoviruses 1, 2, 3, 4, 6, and 7, and parainfluenza viruses 1, 2, 3, 4a, 4b, and 5, did not affect BEP infectivity (Stephano, H. A., Gay, G. M., and Kresse, J., *ibid.*, 1986).

BEP Hosts

Naturally occurring BEP disease has only been confirmed in pigs. Experimentally, BEP affects mice and chicken embryos. Experimentally infected rabbits, dogs, and cats did not show clinical signs, but rabbits produced antibodies (Stephano, H. A., and Gay, G. M., *ibid.*, 1986; Stephano, H. A., Gay, G. M., and Ramirez, T. C., *Ibid.*, 1988).

BEP Epidemiology

Subclinically infected pigs are the main source of the disease. The virus may be disseminated by contaminated people and vehicles. Other sources of infection have not been demonstrated. Wind and possibly birds are considered other means of spread.

Farms that were located 1 to 5 km apart in a valley were affected by blue eye, whereas a farm on a hill 3 km away remained free of the disease. There were no known contacts among the affected farms except by wind and birds. Sentinel pigs introduced to the farm 6 to 12 months after the outbreak remained asymptomatic and did not produce antibodies against BEP (Stephano, H. A., and Gay, G. M. Veterinaria Mexico, *17*:120-122, 1986).

Naturally infected animals developed antibodies that usually persisted throughout their lives. Some affected farms within an enzootic area were affected again 3 years later. Some farms with a continuous system of production had cases periodically.

Blue eye has been most common from March to July, the driest and hottest months of the year, although outbreaks have been observed throughout the year.

The disease appears to be self-limiting. Mortality rates rose rapidly and fell within a short time. Once the initial outbreak was over, no new clinical cases appeared unless susceptible pigs were introduced to an infected farm, as observed on farms operating on a continuous flow pattern.

Of litters farrowed during an outbreak, 20 to 65 percent were affected. In these litters, the morbidity of piglets was between 20 and 50 percent, and the mortality of those affected was between 87 and 90 percent. Piglet mortality lasted from 2 to 9 weeks, depending mainly on the system of management.

Blue eye disease in commercial breeding units has started in any part of the farm, but usually has been first observed in the farrowing house, with central nervous system signs and high mortality in piglets. At about the same time, in closed herds, farmers have observed corneal opacity in some weaned or fattened pigs.

BEP Signs

Clinical signs have varied with the age of the pig. Piglets 2 to 15 days old were most susceptible. Clinical signs appeared suddenly. Affected piglets became prostrate and depressed, and sometimes showed nervous system signs. Fever and an arched back were sometimes accompanied by constipation or diarrhea, followed by progressive nervous signs: ataxia, weakness, rigidity mainly of the hind legs, muscle tremors, and abnormal posture (sometimes a sitting position). Anorexia did not occur while the piglets could still walk. Some piglets were hyperexcitable, squealing and showing paddling movements when handled, and eventually becoming prostrate, generally in lateral recumbency. Other signs included lethargy, with some involuntary movements, dilated pupils, apparent blindness, and sometimes nystagmus. Some piglets suffered from conjunctivitis, with swollen eyelids and lacrimation. The eyelids were often closed and adherent with exudate. From 1 to 10 percent of affected piglets had either unilateral or bilateral corneal opacities. Frequently, corneal opacity was seen in piglets without other signs, often resolving spontaneously. In the first cases observed, piglets usually died within 48 hours of the appearance of clinical signs, but in later cases, death sometimes occurred after 4 or 6 days (Stephano, H. A., Gay, G. M., and Ramirez, T. C., *Ibid.*, 1988).

Most sows with affected litters were clinically normal. Some of them showed moderate anorexia 1 or 2 days before the appearance of clinical signs in their piglets. Corneal opacity has been observed in sows in affected farrowing houses during outbreaks.

Weaned pigs infected at more than 30 days of age showed moderate, transient, clinical signs, such as anorexia, fever, sneezing, and coughing. Nervous system signs were

rare but, when present, consisted of depression, ataxia, circling and swaying of the head. Unilateral or bilateral corneal opacity and conjunctivitis were seen without other signs and continued to appear on the farm for another month. Only 1 percent to 4 percent of pigs more than 30 days old were so affected and the mortality rate was low.

Since 1983, a 20 percent mortality with severe central nervous system manifestations has been observed in 15 kg to 45 kg (33 pounds to 100 pounds) pigs with blue eye disease, but only in poorly managed farms, practicing a weaning and fattening system, receiving animals continuously from different sources. Corneal opacity was present in up to 30 percent of these pigs (Stephano, H. A., and Gay, G. M., *Ibid.*, 1985). Various other diseases have also been diagnosed on these farms.

Gilts and other adult pigs also occasionally developed corneal opacity similar to the ocular disease in affected farrowing sows. In pregnant sows, an increase in the number of animals returning to estrus has been observed for periods of from 6 to 8 months. Some abortions have also been observed. During outbreaks, there have been increases of up to 24 percent in stillbirths and up to 5 percent in mummified fetuses.

In boars, there has been a reduction in fertility associated with an increase in the size of the testicle and epididymis, usually unilaterally, followed by testicular atrophy and hardness of the epididymis in 14 to 40 percent of boars on affected farms.

Gross Lesions

BEP has produced no specific gross changes. A mild pneumonia frequently has been observed in the ventral aspects of the anterior lobes of the lungs. Mild gastric distension with milk in piglets, distension of the urinary bladder with urine, and small accumulations of fluid with fibrin in the peritoneal cavity have also been observed. Congestion of the brain was a common feature. Conjunctivitis, chemosis, various degrees of corneal opacity, corneal vesicles, ulcers, and querantocono also have been observed, with exudate in the anterior chamber. Pericardial and renal hemorrhages have been observed in recent outbreaks (Stepheno, H. A., and Gay, G. M., *Ibid.*, 1988).

In boars, there has been orchitis and epididymitis, followed by testicular atrophy, with or without granuloma formation in the epididymis.

Microscopic Lesions

Histological changes were found mainly in the brain and spinal cord. There was non-suppurative encephalomyelitis in the grey matter of the thalamus, mid-brain, and cerebral cortex, characterized by multifocal, diffuse gliosis, perivascular cuffing of lymphocytes, plasma cells, and reticular cells, neuronal necrosis, neuronophagia, meningitis and choroiditis (Ramirez, T. C. A., and Stephano, H. A., Proc. 7th Internatl. Pig Vet. Soc. Congr., Mexico, D.F.:154, 1982). Intracitoplasmic inclusion bodies were found in neurons. There were variations in the severity and extent of these lesions (Stephano, H. A., and Gay, G. M., *Ibid.*, 1986; Stephano, H. A., Gay, G. M., and Ramirez, T. C. A., *Ibid.*, 1988; Perez, P. F., Stephano, H. A., and Gay, G. M., Proc. 23rd Congr. Mexican Assn. Vet. Specialists in Swine, Leon, Gto. Mexico:81-83, 1988).

There were scattered areas of interstitial pneumonia characterized by thickened septa, with mononuclear cell infiltration.

Changes in the eye were mainly in animals with corneal opacity and consisted of corneal edema, and anterior uveitis with infiltrating neutrophils, macrophages and mononuclear cells, mainly the iridocorneal endothelium. The external layer of the cornea often contained cytoplasmic vesicles, and sometimes intracytoplasmic inclusions in the epithelial cells near the corneo-scleral angle.

Many animals showed mild tonsillitis with desquamated epithelium and inflammatory cells in the crypts.

BEP Diagnosis

Clinical signs in piglets, such as encephalitis, corneal opacity in up to 30 percent of affected piglets, and reproductive failure in sows or orchitis and epididymitis in boars in farrowing houses may suggest the presence of swine blue eye disease. The presence of non-suppurative encephalitis, anterior uveitis, keratitis, orchitis, and epididymitis may also contribute to a presumptive diagnosis.

Hemagglutination-inhibition (HI), viral neutralization, and ELISA tests have been developed to identify positive animals. HI tests have proven most reliable. Direct immunofluorescence tests have been performed in tissue sections and monolayers, using conjugates prepared with rabbit or pig serum.

BEP virus may be readily isolated in PK 15 cell monolayers from brain and tonsil samples. Cytopathic effects are characterized by syncytium formation.

BEP must be differentiated from other causes of encephalitis and reproductive failure (Stephano, H. A., and Gay, G. M., *Ibid.*, 1986; Stephano, H. A., Gay, G. M., and Ramirez, T. C., *Ibid.*, 1988; Stephano, H. A., Sintensis Porcina 5(12):41-48, 1986).

BEP Control

BEP has been eliminated from infected herds by management practices, including herd quarantine, cleaning and disinfecting, and the elimination of clinically affected animals (nervous signs or infertile boars) followed by serological testing, herd performance analyses, and the use of BEP seronegative sentinel pigs to confirm the elimination of BEP (Stephano, H. A., Doporto, J. M., and Gay, G. M., Proc. 9th Internatl. Pig Vet. Soc. Congr., Barcelona, Spain. 456, 1986).

A killed virus vaccine, prepared from cell monolayer cultures, is being developed. Preliminary trials are encouraging. (Dr. H. A. Stephano, Pig Production Department, Veterinary School, University of Mexico, Mexico 04510)

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